

**Case report****Interfragmentary fixation in unilateral zygomaticomaxillary complex fractures: serial cases****Putri Sari Ivanny, Al Hafiz**Department of Otorhinolaryngology Head and Neck Surgery, Faculty of Medicine,  
Andalas University / M. Djamil General Hospital,  
Padang**ABSTRACT**

**Background:** Zygomaticomaxillary complex (ZMC) is an integral part of the facial skeleton in anterolateral prominence thus makes it prone to injury. Common etiologies are including motor vehicle accidents, industrial accidents, sport injuries and interpersonal violence. Interfragmentary fixation technique is one of the surgery procedures for ZMC fracture. **Purpose:** To perform interfragmentary fixation through subtarsal and extended subciliary incision on young and aged patients. **Case Report:** Reported cases of unilateral zygomaticomaxillary fracture in 75 years old male and 37 years old female. **Clinical Question:** Does interfragmentary fixation using mini plates and screws provide good result on face reconstruction of ZMC fractures? **Method:** Literature searching was performed through Cochrane database, PubMed, Clinical Key and Google Scholar. **Result:** The search obtained 65 literatures which were published in the last 10 years, and found 26 articles relevant with the topic. **Conclusion:** Interfragmentary fixation technique is one of surgery procedures for ZMC fractures that gives satisfactory results in terms of function and aesthetics.

**Keywords:** fracture, zygomaticomaxillary complex, interfragmentary fixation, subtarsal incision, extended subciliary incision

**ABSTRAK**

**Latar belakang:** Kompleks zigomatikomaksilaris (KZM) merupakan bagian integral tulang wajah pada anterolateral, menonjol dan cembung sehingga rentan terhadap cedera. Sebagian besar fraktur KZM terjadi akibat kecelakaan lalu lintas, kecelakaan kerja, kecelakaan saat berolahraga dan kekerasan interpersonal. Teknik fiksasi interfragmen merupakan salah satu pilihan tindakan operatif pada fraktur KZM. **Tujuan:** Melakukan teknik fiksasi interfragmen dengan pendekatan insisi subtarsal dan insisi subsiliar berlanjut pada pasien muda dan usia lanjut. **Laporan Kasus:** Dilaporkan dua kasus fraktur KZM unilateral pada pasien laki-laki usia 75 tahun dan perempuan usia 37 tahun. **Pertanyaan klinis:** Apakah fiksasi interfragmen menggunakan plat dan sekrup (plate and screw) memberikan hasil yang baik pada rekonstruksi wajah fraktur KZM? **Metode:** Penelusuran literatur dilakukan melalui Cochrane database, PubMed, Clinical Key dan Google Scholar. **Hasil:** Ditemukan 65 literatur yang diterbitkan dalam 10 tahun terakhir, dan didapatkan 26 artikel yang relevan dengan topik yang dibahas. **Kesimpulan:** Teknik fiksasi interfragmen merupakan salah satu pilihan tindakan operatif pada fraktur KZM.

**Kata kunci:** fraktur, kompleks zigomatikomaksilaris, fiksasi interfragmen, insisi subtarsal, insisi subsiliar berlanjut

**Correspondence address:** Al Hafiz. Department of Otorhinolaryngology Head and Neck Surgery, Faculty of Medicine, Andalas University / M. Djamil General Hospital, Padang. Email: alhafiz@med.unand.ac.id.

## INTRODUCTION

The zygomaticomaxillary complex (ZMC) is an integral part of the facial skeleton in anterolateral position and due to its prominent and convex part of the facial skeleton making it vulnerable to injury.<sup>1-4</sup> ZMC fractures account for 40% of all facial bone fractures.<sup>5</sup> Most cases are found in young men of the second decade.<sup>1</sup> ZMC fractures occur as a result of traffic accidents, work accidents, accidents during exercise and interpersonal violence.<sup>2,5</sup> These injuries can result in both functional (trismus, diplopia and paresthesia) and aesthetics deformities (malar flattening, midfacial widening and globe malposition).<sup>2</sup>

The aim of ZMC fracture management is to fix the deficit both functionally and aesthetically.<sup>1-3,6</sup> This could be achieved through conservative measures, reduction and closed fixation or interfragmentary fixations with various approaches to restore or reconstruct the form of ZMC as prior to trauma with minimal facial soft tissue damage.<sup>1-3,5,6</sup>

## CASE REPORT

### First Case

A 75-year-old male patient was reported with a chief complaint wound on the right cheek that had been stitched 16 hours prior to admission. Previously, the patient fell flat with his face on the asphalt road. There was no pain nor difficulty moving the eyeballs. Blurred vision had been present since before the accident. There was no double vision, no pain and difficulty in opening the mouth, and no numbness on the right side of the face.

Physical examination found the general state was moderately ill. On examination of the right zygoma region there were edema, crepitations, tenderness and there was wound that was stitched, sized 2 cm x1 cm (Figure 1). Facial examination was performed with normal House of Brackmann (HB) I results.

Brain CT-Scan in 3D was performed (Figure 2). The patient was diagnosed with right ZMC fractures + right Le Fort II fracture + nasal bone fracture. It was planned to perform interfragmentary fixation using mini plates and screws and nasal bone repositioning under general anesthesia.

On January 22, 2019 an interfragmentary fixation was installed with mini plates and screws, and also repositioning of nasal bone. There was no fracture fragment found in the incision of right infraorbital scar area. Another incision was performed in the subtarsal area and there were comminuted fractures on the right maxilla, right zygoma, right orbital floor and nasal bone. Interfragmentary fixation was performed with 3 pieces of straight mini plates and fixed with 11 pieces of mini screws sized 1.6 mm x 6 mm. It was followed by open repositioning of nasal bone through an incision aided by a retractor, and fixed with mini plates and screws.

In the 2<sup>nd</sup> month postoperative follow-up, there was occasional facial numbness. There were no pain and difficulty in opening the mouth. There was no chewing disorder. Nasoendoscopy results were within normal limits. The patient was satisfied with the results of surgery both functionally and aesthetically (Figure 3).



Figure 1. Pre-operative images



Figure 2. Brain CT-Scan in 3D. A; right sagittal position, B; front position, C; left sagittal position



Figure 3. 2<sup>nd</sup> month postoperative follow-up images

### Second Case

A 37-year-old female patient was reported with a major complaint difficulty in opening her mouth since 12 days prior to admission. Previously, the patient had a traffic accident. There was no pain in opening the mouth. There were no pain and difficulty in moving the eyeball. There was numbness on the right side of the face. There was no blurry vision. There was no double vision.

Physical examination found that the general state was moderately ill. On oral cavity examination, there was trismus  $\pm$  1.5 cm, malocclusion, and immobilized on bimanual palpation. There were edema and tenderness on the right zygoma and maxillary regions (Figure 4).

Brain CT-Scan in 3D was then performed (Figure 5). The patient was diagnosed with right ZMC fracture + bilateral alveolar fractures, and was planned to undergo interfragmentary fixation using mini plates and screws under general anesthesia.

On February 2, 2019 an interfragmentary fixation was installed with mini plates and screws. An extended subciliary incision was made revealing comminuted fractures on the right maxilla and zygoma. Interfragmentary fixation was performed with 2 pieces of straight mini plates and 1 piece of curve mini plate, then fixed with 12 pieces of mini screws sized 1.6 mm x 5 mm. Next, a vertical incision was performed in the lateral zygoma area and comminuted fractures were found. Then, interfragmentary fixation was done with 1 piece of straight mini plate and fixed with 4 pieces of mini screws sized 1.6 mm x 5 mm. A sublabial incision was made on the right alveolar, and interfragmentary fixation was carried out with 1 piece of L-mini plate and fixed with 3 pieces of mini screws sized 1.6 mm x 6 mm. In the alveolar sinistra, interfragmentary fixation was done with 1 piece of straight plate, then fixed with 4 pieces of mini screws sized 1.6 mm x 6 mm.

In the 7<sup>th</sup> week postoperative follow-up, there was occasional facial numbness. Difficulty in mouth opening still present.



There was no chewing disorder. Examination of oral cavity found there was trismus ± 2 cm (improvement). The patient was satisfied with

the results of surgery, both functionally and aesthetically (Figure 6).



Figure 4. Pre-operative images

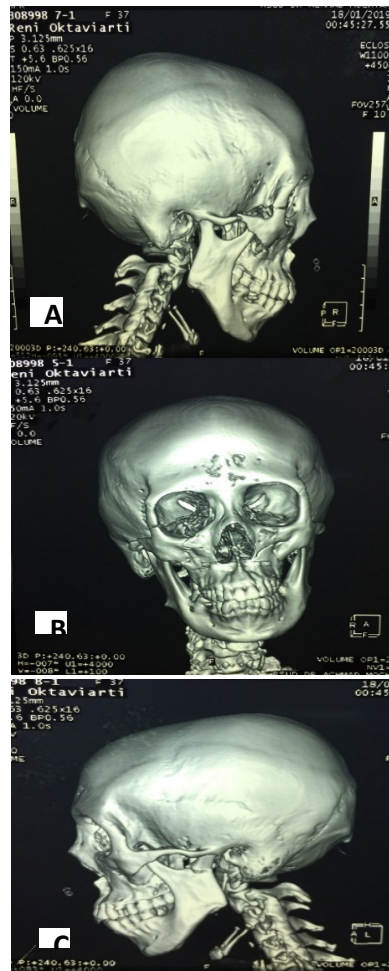


Figure 5. Brain CT-Scan in 3D. A; right sagittal position, B; front position, C; left sagittal position



Figure 6. 7<sup>th</sup> week postoperative follow-up images

## CLINICAL QUESTION

“Does interfragmentary fixation using mini plates and screws provide good result on face reconstruction of ZMC fractures?”

## REVIEW METHOD

Literature searching was performed through Cochrane database, PubMed, Clinical Key and Google Scholar using keywords “ZMC fractures” and “Interfragmentary fixation in maxillofacial fractures.” The search used inclusion criteria: 1) management of ZMC fracture, 2) young population, 3) elderly population, 4) immediate management of ZMC fracture with interfragmentary fixation. The exclusion criteria were patient with another maxillofacial fractures other than ZMC, and nasal bone fracture.

## RESULT

The search obtained 65 literatures which were published in the last 10 years, and found 26 articles relevant with the topic.

ZMC fractures account for 25% of all facial bone fractures.<sup>2</sup> Other literatures report up to 40%.<sup>5</sup> Most are found in male of the second decade.<sup>1,12</sup> Atisha et al<sup>13</sup> (2016) published a study of 2023 patients with facial bone fractures, obtained 209 were aged  $\geq 65$  years, and mostly due to fall trauma (72%) and 1814 patients aged  $< 65$  years which mostly caused by attacks or interpersonal violence (41%).<sup>1</sup> Meanwhile, Liu et al.<sup>9</sup> (2018) reported 319 patients with facial bones fractures aged  $\geq 60$  years (mean age 75.7 years), and 139 were due to falling trauma.

Based on literature review, improvement period of tissue edema within 1-2 weeks in adult patients and within 1 week in children

is reasonable. Entrapment condition is an indication for immediate surgery because it could cause necrosis and fibrosis, which could lead to permanent eyeball movement impairment.<sup>3,11</sup> Interfragmentary fixation technique is one of surgery procedures for ZMC fractures that gives satisfactory results in terms of function and aesthetics.<sup>1-3,5,6</sup>

## DISCUSSION

The first case was a 75 year-old male with diagnosis of ZMC fractures + right Le Fort II fracture + nasal bone fracture. The second case was a 37-year-old female with a diagnosis of right ZMC fractures + bilateral alveolar fractures. In both patients, interfragmentary fixation were carried out using mini plates and screws under general anesthesia by Facial Plastic and Reconstructive Surgery Subdivision, Department of Otorhinolaryngology Head and Neck Surgery.

### Zygomaticomaxillary complex fractures

Clinical symptoms of ZMC fractures are including pain, asymmetrical face due to flattening zygoma area or buccal edema, ecchymosis and periorbital hematoma, epistaxis, deformity of the infraorbital rim area, impaired eyeball movement, visual disturbances such as diplopia, epiphora and drycorneas, enophthalmos or exophthalmus, disorders of opening the mouth (trismus), temporomandibular joint (TMJ) dysfunction, such as malocclusion and hypoesthesia, paresthesia, anesthesia and neuropraxia along the infraorbital nerve distribution.<sup>1,3,4,6,7</sup>

### Interfragmentary fixation

The surgery technique for ZMC fractures with interfragmentary fixation

can be performed by open reduction and internal fixation, mostly using mini plates and screws.<sup>1,5</sup>

Interfragmentary fixation techniques are indicated in broad or mild displaced fractures, comminuted fractures, shifting of infraorbital nerve due to dislocation of bone fragments, disruption of the coronoid process due to dislocation of bone fragments so that disrupted movement to open the mouth, orbital complications such as entrapment, diplopia and enophthalmus.<sup>1,5,6,8</sup>

Contraindications of interfragmentary fixation techniques are including nondisplaced or minimally displaced fractures without functional disturbances, and severe fractures.<sup>6,9,10</sup> The advantages of interfragmentary fixation techniques are adequate visualization, careful handling, and adequate fixation so it will minimize risk of postoperative relapse and provide optimal aesthetics function.<sup>1,3</sup>

Complications could occur due to primary trauma, intra-operative interventions or inaccurate operative management which increases with the complexity of the trauma such as scarring, infection, weakness of facial nerve, neuropraxia, persistent enophthalmus, diplopia, trismus, loss of projections of the malar bone, malunion/non-union and retrobulbar hemorrhage.<sup>1,3,5,8,11</sup>

Adeyemo et al. and Velayutham et al. as quoted by Liu et al.<sup>9</sup> reported that the most commonly fractured area was ZMC. This condition can be explained that the impact of energy is absorbed in different ways by the bony and soft tissue structures of the midface. The absorption is based on a variable bone resistance and strength as well as on the projection of the head at the moment of the impact. The biomechanical forces (Nm) have an important role as a cause of midfacial bone fractures at different locations (Figure 7).<sup>14</sup>

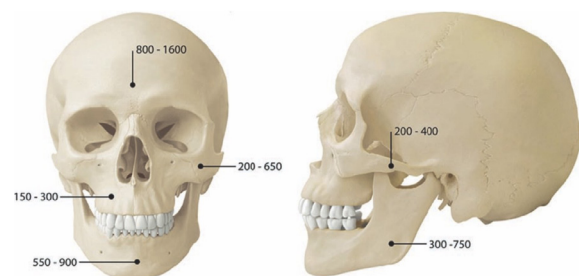
Based on the time of onset of trauma, the management of facial fractures is divided into acute management (within 72 hours after trauma), immediate (within 2 weeks) and delayed (after 2 weeks).<sup>8</sup> When there was no entrapment, retrobulbar haemorrhage or apex syndrome in superior orbital fissures found, ZMC fractures do not require emergency intervention. Waiting for tissue edema to subside within 1-2 weeks in adult patients is still acceptable because bone consolidation occurs between 2-3 weeks after trauma and could be faster in children so that treatment could be implemented within 1 week.

This is because the condition of edema will camouflage the actual degree of deformity (Figure 8), so it could be expected that after edema diminish, the operator will be able to do an adequate evaluation and appropriate surgery planning. The DMC fracture management after 4 weeks will require osteotomy and bone grafting which will increase complexity of the reconstruction. However, if entrapment conditions are found on physical examination and also on CT-Scan 3D, this condition is an indication for immediate surgery because it could instigate necrosis and fibrosis that could cause permanent limited eyeball movement.<sup>3,11</sup>

This is because the condition of edema will camouflage the actual degree of deformity (Figure 8), so it is expected that after edema diminished, we will be able to do an adequate evaluation and appropriate operative planning. Management after 4 weeks will require osteotomy and bone graft which will increase complexity during reconstruction. However, if entrapment conditions are found on physical examination and CT-Scan 3D, then this condition is an indication for immediate emergency surgery because it could cause necrosis and fibrosis so that permanent retention of eyeball movement occurs.<sup>3,11</sup>

The choice of approach route depends on the area and location of the fracture. Alternative approaches of ZMC fractures

are carried out with “less-is-more” principle where preservation of soft tissue can be done through post-traumatic scars so that no additional incisions are needed. This is because the location of the fracture is usually adjacent to the lesion in the facial soft tissue so that it can be used as an entry point to performed interfragmentary fixation. If access to the fracture area is inadequate, the incision can be widened according to the relaxed skin tension line (RSTL).<sup>3,11</sup>



**Figure 7. Biomechanical forces (Nm) necessary to cause fractures of the facial skeleton at different locations. Note the differences between mandible, midface, and cranio-frontal region<sup>13</sup>**

In the first patient, a right subtarsal incision was made because the fracture fragment could not be found in the post-trauma scar. The selection of subtarsal incision was made in consideration to gain adequate access to the inferior orbital rim area and orbital floor. The incision could be extended latero-inferiorly following the RSTL. In addition, incision in the subtarsal area was simpler, and could disguise scarring according to RSTL and minimized complications. Predictable complications such as skin or septal button hole, ectropion and entropion were not found. Compared to subciliary incisions, subtarsal incisions have a lower risk of ectropion with more satisfying aesthetic results (Figure 9).<sup>3,6,7</sup>

In the second patient, an extended subciliary incision was made. Malaviya et al.<sup>6</sup> stated that the selection of a subciliary incision or also known as infraciliary or blepharoplasty incision could be performed for gaining access to the lateral orbital rim



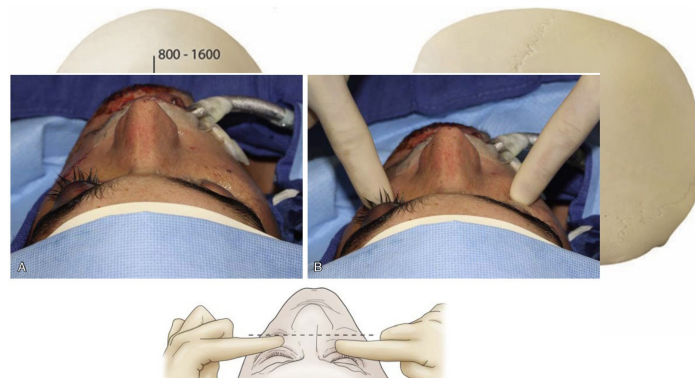
area, infraorbital rim and orbital floor. The advantage of this incision is that scar could be disguised. However, this technique is more difficult and the risk of ectropion is greater.<sup>6,7</sup>

Standard management of interfragmentary fixation mostly uses mini plates and screws. To date there is no consensus on adequate qualification of fixation. Expert practitioners recommend three-point fixation for ZMC fractures based on biomechanics studies.<sup>1,6</sup>

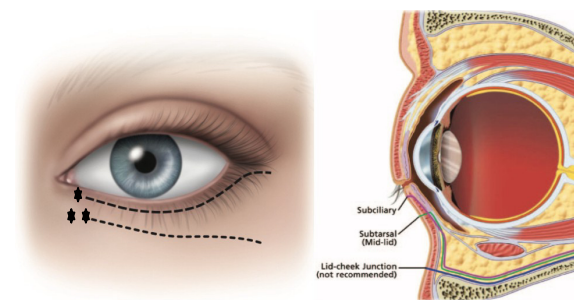
The use of bioabsorbable plates and screws began to be used in ZMC fractures because it is relatively lighter. Other advantages are it could be performed with simpler techniques, safer and minimal long-term effects. In addition, the use of bioabsorbable materials does not require the removal of material later on, minimal disruption of bone growth in children and postoperative radiotherapy, does not interfere with postoperative imaging, not affected by cold weather and easy placement on dental implants.<sup>10,15</sup> However, that does not mean

the use of bioabsorbable materials has no limitations. Inadequate stability, difficult techniques, infections, edema and formation of granulation tissue are the limitations of the use of bioabsorbable materials. This is because bioabsorbable material is thicker and wider than titanium so it may complicate the fixing of small bone fragments. In addition, the strength of bioabsorbable material is not sufficient as a bridge in the unstable comminuted fracture segments.<sup>3,10,15</sup>

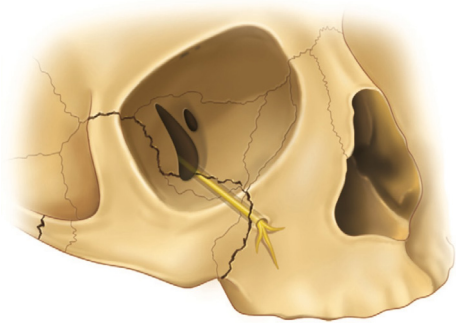
One study reported that the involvement of infraorbital nerve in ZMC fractures reached up to 95% of cases.<sup>16</sup> Damage that occurred could be as a result of direct trauma that extends through the orbital floor and/or anterior maxilla causing tear, cut or compression of infraorbital nerve as this nerve passes through the canal to innervate the midfacial structure (Figure 10).<sup>7,16</sup> Complaints of hypoesthesia, anesthesia and neuropraxia along the distribution of infraorbital nerve might improve in 2-6 months.<sup>17</sup>



**Figure 8. Facial swelling after trauma may mask a deformity that is easily palpated. A. bird eye view demonstrating symmetric appearance due to edema. B. Palpating malar regions reveals depressed right zygomaticomaxillary complex (ZMC). C. Artist depiction of palpating depressed right ZMC.<sup>9</sup>**



**Figure 9. Subciliary incision (\*) and subtarsal incision (\*\*)<sup>3,7</sup>**



**Figure 10. Typical fracture extends frequently across the infraorbital foramen on the facial surface of the maxilla with multiple lines of fracture crossing the infraorbital neurovascular bundle.<sup>7</sup>**

The choice of surgery measures for ZMC fractures in the elderly population is a complex decision as its limitations of health factors and the minimum attention to aesthetics.<sup>13</sup> Cortese et al.<sup>4</sup> in 2016 published the results of studies in the elderly population in which the main indications in most patients with ZMC fractures were aesthetic deformity. Eye and palpebra were important determinants of facial aesthetics. The use of Platelet-Rich Fibrin (PRF) could help improve the age-related drooping of inferior palpebra or complications from the incision that might give an asymmetrical facial appearance that looks unnatural. PRF is a biomaterial gel that contains several high concentrated growth factors including platelet-derived growth factor, transforming growth factor, vascular endothelial factor and endothelial growth factor all of which are secreted by platelets. PRF will stimulate and accelerate tissue repair and bone regeneration, reduce postoperative edema and pain and prevent infection. Leukocytes in the PRF also contribute to prevent infection by increasing immunity and producing large amounts of vascular endothelial growth factor.

The decision to implement interfragmentary fixation techniques in ZMC fractures using mini plates and screws through the

subtarsal and extended subciliary incision approach with the principle of “less-is-more” produced satisfactory results in terms of function and aesthetics.

## REFERENCE

1. Peretti N, MacLeod S. Zygomaticomaxillary complex fractures: Diagnosis and treatment. *Curr Opin Otolaryngol Head Neck Surg.* 2017; 25(4): 314-9.
2. Strong EB, Gary C. Management of Zygomaticomaxillary Complex Fractures. *Facial Plast Surg Clin North Am.* 2017; 25(4): 547-62.
3. Birgfeld CB, Mundinger GS, Gruss JS. Evidence-Based Medicine: Evaluation and Treatment of Zygoma Fractures. *Plast Reconstr Surg.* 2017; 139(1): 168e-180e.
4. Cortese A, Caggiano M, Carlino F, Pantaleo G. Zygomatic fractures: Technical modifications for better aesthetic and functional results in older patients. *Int J Surg.* 2016; 33: S9-S15.
5. Farber S, Nguyen D, Skolnick G, Woo A, Patel K. Current Management of Zygomaticomaxillary Complex Fractures: A Multidisciplinary Survey and Literature Review. *Craniomaxillofacial Trauma Reconstr.* 2016; 09(04): 313-22.
6. Malaviya P, Choudhary S. Zygomaticomaxillary buttress and its dilemma. *J Korean Assoc Oral Maxillofac Surg.* 2018; 44:151-8.
7. Ellis E. Fractures of the Zygomatic Complex and Arch. In: Fonseca R, Walker R, Barber H, Powers M, Frost D, eds. *Oral & Maxillofacial Trauma.* 4th eds. Missouri: Elsevier; 2013: 354-415.
8. Chouinard AF, Troulis MJ, Lahey ET. The Acute Management of Facial Fractures. *Curr Trauma Reports.* 2016; 2(2): 55-65.
9. Liu F, Halsey J, Oleck N, Lee E, Granick M. Facial Fractures as a Result of Falls in the Elderly: Concomitant Injuries and Management Strategies. *Craniomaxillofacial Trauma Reconstr.* 2018; 1(212).
10. Wu CM, Chen YA, Liao HT, Chen Chao, Pan CH, Chen CT. Surgical treatment of isolated zygomatic fracture: Outcome comparison

- between titanium plate and bioabsorbable plate. *Asian J Surg.* 2018; 41(4):370- 6.
11. Tucker T, Salman S, Cunningham L. Management of Zygomatic Fractures. In: Fonseca R, Turvey T, Costello B, Ruiz R, eds. *Oral and Maxillofacial Surgery*. 3rd ed. Missouri: Elsevier; 2018:189- 210.
  12. Starch-Jensen T, Linnebjerg LB, Jensen JD. Treatment of Zygomatic Complex Fractures with Surgical or Nonsurgical Intervention: A Retrospective Study. *Open Dent J.* 2018; 12(1): 377-7.
  13. Atisha DM, Van Rensselaer Burr T, Allori AC, Puscas L, Erdmann D, Marcus JR. Facial Fractures in the Aging Population. *Plast Reconstr Surg.* 2016; 137(2): 587-93.
  14. Hardt N, Kuttenger J. Mechanism of Craniofacial Fractures. In: Hardt N, Kuttenger J, eds. *Craniofacial Trauma Diagnosis and Management*. 1st ed. Switzerland: Springer; 2010: 55-61.
  15. Mahmoud SM, Liao HT, Chen CT. Aesthetic and Functional Outcome of Zygomatic Fractures Fixation Comparison With Resorbable Versus Titanium Plates. *Ann Plast Surg.* 2016; 76 (March): S85- S90.
  16. Noor M, Ishaq Y, Anwar MA. Frequency of infra-orbital nerve injury after a Zygomaticomaxillary complex fracture and its functional recovery after open reduction and internal fixation. *Int Surg J.* 2017; 4(2): 685-9.
  17. Hwang K, Kim DH. Analysis of zygomatic fractures. *J Craniofac Surg.* 2011; 22(4):1416-21.